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SPECIFICATION

LOW POSITIVE PRESSURE CANNED FOOD HAVING AN INTERNAL PRESSURE INSPECTION APTITUDE AND CAN THEREFOR

TECHNICAL FIELD

The present invention relates to low positive pressure canned food having an internal pressure inspection aptitude and a can therefor, and particularly to low positive pressure canned food having an internal pressure inspection aptitude and a can therefor, which can be subjected to internal pressure inspection with accuracy equal to inspecting heretofore applied to internal pressure inspection for negative pressure canned food.

BACKGROUND ART

With respect to canned food for low acid drinks, for example, such as drinks with milk which are very liable to be spoiled and putrid, sealing properties after filling and putrefaction of contents are obliged to be inspected. For such an inspection of sealing properties after filling and putrefaction of contents as described, an inspection method called-an-tap-test manner is generally employed in which a can lid or a can bottom is hit by an electromagnetic pulse to generate vibrations, and internal pressure is inspected by a mutual relation between the generated sound (frequency) and can's internal pressure, and the sealing properties and presence of swell caused by a growth of microorganisms are inspected by excess and shortage of internal pressure. Since low acid drinks are generally subject to hot pack and retort processing, canned food of low acid drinks results in negative pressure canned food because hen contents cools to a normal temperature, negative pressure occurs due to contraction of the contents and gas in a head space. The negative pressure canned food has a vacuum degree in the range of from approximately 20 to 60 cm Hg. Since an dispersion of pressure is small and a change of proper frequency to a change of internal pressure is large, a detection resolving power resulting from tap test is high, there is an advantage that detection of leakage and spoilage of contents can be accomplished accurately by tap test.

However, the negative pressure can poses a problem that since a can having a high rigidity resisting to negative pressure is necessary and the negative pressure can has a side wall which is greater in thickness than that of a positive pressure can, the cost of cans is high.

On the other hand, there is positive pressure canned food in which an inert gas (liquefied or solidified) such as liquid nitrogen is filled at the time of sealing whereby positive pressure is generated within a can due to vaporization and swell of liquid nitrogen or the like to provide the rigidity by can internal pressure. In the positive pressure can food, can internal pressure is normally 1.0 ±0.3 kgf/cm^2 (gauge pressure, the same is true hereinafter) or so. At retort, the can internal pressure reaches 6.0 kgf/cm^2 or large, and a can bottom is formed into a dome shape which is inflated inwardly of a can in order to resist to internal pressure thereof. In comparison with the negative pressure canned foods, the positive pressure canned foods are applied positive pressure to the inside of the can, and therefore, the positive pressure canned food is hard to be hollowed against external pressure so that it can be thinned in plate thickness, thus providing an advantage that can materials can be cut to reduce the cost of cans.

As described above, the positive pressure canned food may be used in order to make the wall-thickness of cans thin. However, the conventional positive pressure canned food is not sufficient in quality guaranteeing property due to the lack of internal pressure inspection aptitude for the reasons mentioned below. Therefore, the contents of low acid drinks, for example, such as drinks with milk, have been heretofore applied to negative pressure canned food made of steel having a relatively thick in plate thickness such that the plate thickness of a can bottom is about 0.24 to 0.26 mm, and that of the can is about 0.2 mm. The positive pressure canned food has been merely applied to contents that are relatively hard to be spoiled and putrid.

(1) In the case of positive pressure canned food, since internal pressure is generated by gas filled, an dispersion of internal pressure is large in comparison with negative pressure canned food. In conventional gas exchange positive pressure canned food, an dispersion of internal pressure with respect to set internal pressure is ±0.3 kgf/cm^2 or large. Positive pressure canned food have not yet been provided in which an dispersion of internal pressure with respect to set internal pressure is ±0.3 kgf/cm^2 or small. Therefore, even if can internal pressure can be measured accurately, a range of dispersion is so large that distinction cannot be made whether the can internal pressure measured is caused by the spoilage of contents or caused by the dispersion of the amount of gas filled, making it difficult to accurately detect spoiled cans.

(2) In the case of a positive pressure can whose bottom has a dome shape in order to strengthen pressure resistance, a bottom wall is hard to be changed against internal pressure, and an accurate change in internal pressure cannot be inspected by internal

pressure inspection such as tap test by a bottom portion. This can lacks in quality guarantee as canned food for contents that are liable to be spoiled.

(3) Further, in the case of positive pressure canned food according to a conventional gas exchange method, since can internal pressure is generally high, say, 1.0 ± 0.3 kgf/cm^2, even if a fine change of internal pressure due to a fine leakage or putrefying occurs, detection thereof is difficult because variation of internal pressure with respect to the entirety is low. In addition, in the case where tap test is carried out for a lid or a bottom, accurate internal pressure inspection cannot be made because of an internal pressure region which is less in change of vibration characteristics with respect to the change in can internal pressure. Further, in the case where can internal pressure is detected by a displacement amount of a lid, a bottom or the body, and also in the case where the body or the like is pressed by the fixed pressure to measure reaction thereof thereby detecting the can internal pressure, a rigidity of a can increases in such an can internal pressure so that an amount of change of displacement or reaction is small, thus making it difficult to make internal pressure inspection.

(4) When the positive pressure canned food by the conventional gas exchange method is subject to retort sterilization processing, internal pressure increases at the time of retort processing and the positive pressure state further increases in pressure. Thus, the strength resisting to the internal pressure, particularly the pressure resisting performance of a can bottom or a lid that is liable to induce buckling is demanded. Accordingly, the conventional bottom shape for a negative pressure can is difficult to withstand the retort processing in terms of strength. It is necessary for providing canned food needed for the retort processing to make a can bottom thick, thus disappearing an advantage of positive pressure canned food which is employed to make a plate material thin.

DISCLOSURE OF THE INVENTION

Accordingly, the present invention solves at a stroke the problem of positive pressure canned food which lacks in internal pressure inspection aptitude as described above to enable employment of thin wall-thickness can materials for canned food of low acid drinks such as drinks with milk. More specifically, an object of the invention is to provide a low positive pressure canned food having an internal pressure inspection aptitude and a can therefor, which is excellent in internal inspection aptitude such as tap test, is high in detection performance in leakage and spoiling, can withstand a rise in internal pressure at

the time of retort processing, and can make container materials thin to reduce the cost of cans.

For solving the aforementioned problem, the present invention provides positive pressure canned food having an internal pressure inspection aptitude in which contents are filled and sealed so that can internal pressure is at least in a positive pressure state with respect to at least the outside atmospheric pressure, characterized in that said can internal pressure is in a range of from 0.2 to 08 kgf/cm^2, preferably 0.2 to 0.6 kgf/cm^2 at room temperature so as to have an internal pressure inspection aptitude. Preferably the can internal pressure is that in a range of set internal pressure of from 0.2 to 0.8 kgf/cm^2, dispersion is $\pm$0.2 kgf/cm^2 or less, preferably, $\pm$0.1 kgf/cm^2 or less. When the dispersion is $\pm$0.2 kgf/cm^2 or large, reliability of detection of a fine change in internal pressure caused by a fine leakage or spoiling becomes low, which is not preferable. It is noted that the internal pressure inspection aptitude termed herein refers to the performance in which for example, in the case where internal pressure inspection is carried out by tap test, resplendence of sounds (frequency) generated by striking is good even with respect to a fine change in can internal pressure; in the case where internal pressure inspection is carried out by measuring a displacement of an outer circumferential portion of canned food by means of a displacement meter, respondents of displacement of a measured part with respect to a fine change in can internal pressure is good; and in the case where a measured part of an outer circumferential portion of canned food is pressed by the fixed pressure to measure reaction thereof thereby carrying out internal pressure inspection, resplendence of reaction is good with respect to a fine change in can internal pressure so that internal pressure can be measured accurately.

For reducing the cost of cans, a seamless can having the body and a bottom molded integrally is desirable, and a more desirable can is that a bottom of the can has an annular ground portion, the annular ground portion being internally provided with a bottom wall in the form of a substantially flat, and the bottom has an internal pressure inspection aptitude. It is noted that in the case of a seamless can in which a bottom has a dome shape, an end or the body has an internal pressure inspection aptitude.

The aforementioned range of the can internal pressure from 0.2 to 0.8 kgf/cm^2, preferably 0.2 to 0.6 kgf/cm^2 has been confirmed as the range in which as shown in a graph of FIG. 5, in tap test, the rate (inclination) of vibration frequency of the bottom to the change in can internal pressure is so large that the vibration frequency greatly changes with respect to a slight change in internal pressure, and measurement of can internal

pressure can be well detected. This range is in a positive pressure state corresponding to a vacuum degree of a negative pressure can, and it means that tap test can be made with the same accuracy as the tap test for a negative pressure can. If the can internal pressure is out of the above range, a change in vibration frequency with respect to a change in can internal pressure is small, resulting in inferior judgement. Further, when the can internal pressure is higher than 0.8 kgf/cm^2, in the case of canned food subject to retort processing, a pressure difference between inside and outside of a can becomes too high at the time of retort processing, and in the bottom shape provided with the substantially flat as described above, a can material should be increased in thickness to maintain pressure resistance and the internal pressure inspection aptitude is deteriorated. Further, in the case where within the range of the can internal pressure, a displacement amount of a lid and a bottom or the body is measured by a change in can internal pressure to carry out internal pressure inspection, there is a good internal pressure inspection aptitude except the dome-shaped bottom having a high form rigidity, but in can internal pressure which is lower than 0.2 kgf/cm^2 which is out of the above range of can internal pressure, judgement of sealing guarantee is insufficient, and in the range of can internal pressure higher than 0.8 kgf/ cm^2, the rigidity of a can increases so that a changing amount of displacement is small, thus making it difficult to perform accurate internal pressure inspection.

In the positive pressure canned food, the contents and the canned food making method are not particularly limited but can be suitably applied to those in which the contents comprise low acid drinks, which are sealed in positive pressure by the gas exchange method and subjected to retort sterilization processing after filling and sealing, any one of the bottom, body, and the lid has the internal pressure inspection aptitude. The gas exchange method termed herein includes not only the case where an inert gas such as nitrogen gas is blown into a head space for substitution but also the case where a liquefied gas such as liquid nitrogen or a solidified gas such as dry ice is filled in a can, and positive pressure is generated in the can by a vaporization swell thereof.

A can used for the low positive pressure canned food according to the present invention comprises configuration in which the body and a bottom are integrally molded seamlessly, the bottom has an annular ground portion in the vicinity of an outer circumferential portion, the inside of the annular ground portion constitutes an internal rising wall which rises inwardly of a can, and the internal rising wall is internally formed with a bottom wall which is in a substantially flat shape and has a height of from 0.5 to 6 mm from a ground position, a central portion of the bottom wall having an tap test aptitude.

The shape of the can bottom is desirable that a bottom of the internal rising wall of the annular ground portion is formed with an annular bead whose depth from a surface of the bottom wall inwardly of a can is 0.1 to 4 mm, and is desirable that a ground diameter of the can bottom is 70 to 98% of a diameter of the can, and a diameter of a flat of the can bottom is 60 to 90% with respect to the ground diameter. Desirably, an angle of inclination of the rising wall is 65 to 110° . The annular bead is not merely limited to an inverted U-shape in section but may be formed so as to have a gradually inclined portion that is gradually inclined from the top thereof toward the bottom wall and continuous to the bottom wall. It is to be noted that one or more annular beads may be formed.

When a height of the flat portion of the bottom wall from the ground position is 0.5 mm or lower, the bottom deformed after retort tends to be convex below the ground position, and when it is higher than 6 mm, a thickness of the portion from the ground portion toward the rising portion is reduced due to molding, and it causes the pressure resistance lowered. Further, the amount of contents with respect to the height of a can decreases, and the cost of materials relatively increases, which is not preferred.

When the depth of the annular bead is shallower than 0.1 mm, the effect of the central portion of the bottom wall to the pressure resistance is not fully obtained, and when it is deeper than 4 mm, molding is difficult. Therefore, the above-described range is desirable. Further, when the inclination angle of the rising wall is smaller than 65° , the pressure resisting performance of the ground portion lowers, and an area of the flat of the bottom wall becomes small to cause the internal pressure inspection aptitude to be deteriorated, and when it is larger than 110° , molding is difficult.

Metal materials of cans applied to the present invention include metal plates such as tin, ECCS (Electrolytically Chromium Coated Steel) and a surface-treated steel plate, or a laminate plate in which a synthetic rein such as a polyester film is laminated on the above-described metal plates. Materials, making methods and forms of cans, for example, seamless cans made by molding process in combination of ordinary draw and ironing, stretch process or the like, or 3-piece cans in which ends are seamed as a bottom portion, are not particularly limited. According to the present invention, it is possible to make a wall-thickness thin to a range in which a plate thickness of a can bottom is 0.15 to 0.2 mm in case of steel material, and 0.25 to 0.35 mm in case of aluminum material.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a main part of a can for low positive pressure canned food according to an embodiment of the present invention;

FIG. 2 is a schematic view of the main part;

FIGS. 3-A, 3-B, 3-C, 3-D, and 3-E are respectively schematic views of main parts of can bodies for low positive pressure canned food according to another different embodiments of the present invention;

FIGS. 4-A and 4-B are respectively graphs showing a displacement amount of a can bottom with respect to can internal pressure; FIG. 4-A showing a can according to an embodiment shown in FIG. 1, FIG. 4-B showing a can shown in FIG. 3-A; and

FIG. 5 is a graph showing a comparison of can internal pressure-frequency distribution of tap test between can bottoms of positive pressure canned food and negative pressure canned food.

BEST MODE FOR CARRYING OUT THE INVENTION

For describing the present invention in more detail, the present invention will be described hereinafter with reference to the accompanying drawings.

FIG. 1 is a sectional view of a main part of a can for low positive pressure canned food according to an embodiment of the present invention. A can 1 according to the present embodiment comprises a two-piece can (a seamless can) in which the body and a bottom are integrally molded, which is made of a steel plate or an aluminum plate, or a composite having a PET film or the like laminated thereon, and which is molded by draw and ironing process, or process in combination of these process with stretch process or the like. The bottom of the can 1 has a crest annular ground portion 3 and a root annular bead 5 between the body wall 2 and a bottom wall 6. The bottom of the internal rising wall 4 of the annular ground portion 3 is protruded inwardly of a can and spoiled back to thereby form an annular bead 5 having an inverted U-shaped in section protruded inwardly of a can. The bottom wall 6 inside of the annular bead is formed into a flat shape in its whole area in the present embodiment.

An angle of inclination α of an external rising wall 7 of the annular ground portion 3 and an angle of inclination β of the internal rising wall 4 are formed in a range of 5° to 30° and 65° to 110°, respectively. It is necessary for a height h from the ground position to the center of the bottom wall that a bulge remained in the bottom wall when the can bottom is expanded as internal pressure rises at the time of retort processing and a temperature returns to a room temperature is not protruded outward from the annular ground position, the height h being formed in the range of 0.1 to 10 mm, preferably 0.5 to 6 mm. It has been confirmed that the annular bead 5 performs its duties of increasing a

pressure resisting strength of the bottom with respect to internal pressure, and if a depth is deepened to some degree, the pressure resisting strength enhances. The presence of the annular bead 5 has a function of increasing the pressure resisting strength of the bottom because with respect to the bulge externally of the flat bottom wall as the internal pressure rises, the shape of the annular bead increases the rigidity of vicinity, and an amount of deformation of the central portion of the bottom is suppressed. For obtaining this effect, the depth m of the annular bead 5 may be in the range of 0.1 to 5 mm, preferably, 0.1 mm to 3 mm. It has been confirmed that a ground diameter of the annular ground portion 3 is formed in the range of 70 to 98% of the can diameter in terms of self-supportability and strength, and a diameter of the flat of the bottom wall is formed in the range of 60 to 90% with respect to the ground diameter of the annular ground portion to thereby provide a range for the good internal pressure inspection aptitude at the bottom.

By forming the bottom into the shape as described above, the pressure resisting strength of the bottom wall is improved, and it is possible to obtain a pressure resisting strength capable of withstanding a pressure difference 5 kgf/cm^2 between inside and outside of a can estimated at the time of retort sterilization processing for a thin 2 piece can. This pressure resisting strength is the strength capable of withstanding the elevation of pressure when the retort processing necessary for sterilization of contents is carried out. The wall thickness of the can bottom is in a range of maintaining the pressure resisting strength and making a plate material as thin as possible. Suitable range therefor is 0.15 to 0.25 mm in case of steel material, and 0.25 to 0.35 mm in case of aluminum material because, aluminum is inferior in pressure resisting properties to steel.

In the present embodiment, a bottom of a can has a shape as described above. An embodiment of a low positive pressure canned food having a tap test aptitude according to the present invention using the aforesaid can will now be described.

A low acid drink with milk is hot-packed in a can, into which is filled a liquid nitrogen or dry ice or other inert gases (hereinafter merely referred to as nitrogen or the like) and the can is sealed. In this case, can internal pressure at room temperature after nitrogen or the like has been filled is set so as to be 0.2 to 0.8 kgf/cm^2, preferably 0.2 to 0.6 kgf/ cm^2, which is lower than positive pressure canned food normally employed. Further, a filling amount of nitrogen or the like is controlled so that the can internal pressure may maintain the accuracy of $\pm$ 0.2 kgf/ cm^2, preferably $\pm$0.1 kgf/ cm^2 to fill and seal it. In the present invention, it is important that the can internal pressure is set to be low and the dispersion of the can internal pressure is to be small as described

above. Thereby, it is possible to discriminate whether or not the can internal pressure detected is caused by spoiling or by mere dispersion of can internal pressure. For inspections of can internal pressure, bottom tap test heretofore used in a negative pressure can is carried out to thereby enable accurate detection of spoiling.

As a method for obtaining set internal pressure with accuracy by gas exchange, there can be employed simultaneously a method of filling a mist-like liquefied gas such as liquid nitrogen or the like or dry ice, and a low temperature inert gas such as nitrogen gas or the like into a head space of a can filled with contents immediately before rolling. Air in the headspace is expelled for gas exchange by blowing a blend of a mist-like liquefied gas or dry ice having an appropriate particle diameter and an inert gas. The liquefied gas or dry ice that is vaporized into the inert gas is formed into mist-like fine particles whereby influence of viscosity is more powerful than that of an inertia force during rolling by a seamer. Therefore, there is not affected by a centrifugal force caused by rotation of a can, and the liquefied gas or dry ice is not splashed outside but stayed in the can. After sealing, vaporization swell thereof and temperature swell of low temperature gas generate internal pressure in the can to always obtain a fixed internal pressure irrespective of dispersion of the content amount. By controlling the rate between vaporization expansion and thermal expansion, filling internal pressure can be can be controlled and the desired can internal pressure is obtained with high accuracy and in a stable manner. Next, in the step of retort sterilization processing carried out after filling and sealing, the retort sterilization processing is carried out so that a pressure difference between inside and outside of a can at the time of retort processing is within 5 kgf/cm^2. The pressure difference 5 kgf/cm^2 between inside and outside of a can means that since in the present invention, the can internal pressure before the retort sterilization is set to 0.2 to 0.8 kgf/cm^2, preferably 0.2 to 0.6 kgf/ cm^2, elevation of pressure at the time of retort sterilization processing can be allowed to 4.2 to 4.8 kgf/cm^2. This elevation of pressure is the range capable of securing the retort processing enough to perform sterilization processing for low acid drinks that are contents.

In the canned food produced through the steps as described above, deformation such as buckling can be suppressed against elevation of can internal pressure at the time of retort sterilization processing despite the thin can principally made of steel or aluminum, and the can bottom is provided with a sufficient pressure resisting performance. Moreover, since there is accuracy that the can internal pressure is $\pm$0.2 to 0.8 kgf/ cm^2, preferably $\pm$0.2 to 0.6 kgf/ cm^2, spoiling of contents can be detected. Further, since at

least a center portion of the bottom of a can is in the form of a flat surface, the tap test aptitude is excellent. Therefore, according to the present invention, low acid drinks requiring the retort sterilization are filled for a thin 2 piece can to provide the pressure resisting strength and secure the sufficient spoiling detection performance for contents. Thereby, cans can be thinned and reduce in weight in comparison with conventional low acid drink cans, even aluminum cans can be used to reduce the cost of a can.

While on embodiment of the present invention has been described above, it is to be noted that the present invention can be variously changed within a scope of technical idea thereof and is not limited to that of the aforementioned embodiment. Further, while in the above-described embodiment, the case has been described where the internal pressure inspection is carried out by tap test, it is to be noted that the positive pressure canned food according to the present invention is not always limited to tap test. For example, internal pressure inspection carried out by measuring a displacement of outer peripheral portions of canned food such as a end portion and a bottom or the body of canned food using a displacement meter to convert it into an can internal pressure state, or internal pressure inspection carried out by pressing the outer peripheral portions of canned food under fixed pressure and measuring reaction thereof to convert it into an can internal pressure state can be also suitably applied. Even if any of these internal pressure inspection methods is employed, it is necessary that frequency, the displacement amount or the change of reaction are easily measured accurately, and the range of internal pressure capable of detecting a spoiled can is set. It has been therefore confirmed in the present invention that low positive pressure canned food having the most preferable internal pressure inspection aptitude is obtained by setting can internal pressure to the range of 0.2 to 0.8 kgf/cm^2, preferably 0.2 to 0.6 kgf/ cm^2, and maintaining the accuracy of ± 0.2 kgf/cm^2, preferably ± 0.1 kgf/cm^2 relative to the can internal pressure. Further, the contents are not always limited to the low acid drinks.

FIGS. 3(A) to 3(E) show various embodiments with shapes of a bottom of a can deformed.

Even if these shapes are employed, similar effect can be obtained. In the ensuing embodiments, only the portions different from the can in the embodiment sown in FIG. 1 will be explained. A can 10 in FIG. 3 (A) is that an angle of inclination β of an internal rising wall 12 of an annular ground portion 11 is made somewhat large, and an annular bead 13 has a gradually inclined portion 13' that is gradually inclined in a linear manner from the top toward a bottom wall 14 and continuous to the bottom wall.

A can body 15 in FIG. 3 (B) is particularly different in shape of a bottom wall. In this embodiment, a bottom wall 17 has its center portion 17' which is flat but an outer peripheral portion 17" is formed to be inclined toward an end of a gradually inclined portion 16' of an annular bead 16. A can 20 in FIG. 3 (C) is characterized in that an annular ground portion 21 is wholly formed to be wide. More specifically, the annular ground portion 21 has a gradually inclined surface 21" from an extreme end 21' thereof to form an internal rising wall 22 continuous to an annular bead 23 from the gradually inclined surface. A can 25 in FIG. 3 (D) has an annular ground portion 26 which is formed to be wider than that of the embodiment shown in FIG. 3 (A) but to be narrower than the annular ground portion 21 of the embodiment shown in FIG. 3 (C), and a surface of a bottom wall 27 is formed to be high. A can 30 in FIG. 3 (E) is that two annular beads, i.e. a concave bead 32 and a convex bead 33 are formed between an annular ground portion 31 and a flat bottom wall 34.

Example 1

Drawing-wiping and stretch processing was applied to a blank of a surface-treated steel plate having a thickness of 0.18 mm with polyester films laminated on both sides thereof to form a seamless can whose diameter of the body is 53 mm, a ground diameter is 46.8 mm, an angle of inclination β of an external rising wall is 78° , a height h of a bottom wall surface from a ground position is 3.3 mm, a diameter of a flat portion of a bottom wall is 35.6 mm, a depth from a flat surface to an annular groove is 1.9 mm, an angle of inclination thereof is 43° , and a height of a can is 100 mm. A wall-thickness of a can bottom portion was 0.18 mm.

190 g of milk coffee was filled in the thus formed seamless can, and liquid nitrogen was filled therein so as to generate 0.5 ± 0.1 kgf/cm^2 of can internal pressure, after which sealing by seaming were carried out, and after this, heating and sterilization and cooling in the normal retort processing step were carried out to obtain 1000 positive pressure canned food. It has been confirmed that the obtained canned food is free from abnormal deformation of cans and has a pressure resisting strength for the retort processing. It has been confirmed after carrying out the tap test for all the cans obtained that the all cans have proper inspecting accuracy for internal pressure and have inspecting aptitude.

Comparative Example 1

A seamless can formed similarly to Example 1 was used. 190 g of milk coffee was filled in the thus formed seamless can, and liquid nitrogen was fill d therein so as to

generate 1.0 ± 0.1 kgf/cm^2 of can internal pressure, after which seaming and sealing were carried out, and after this, heating and sterilization and cooling in the normal retort processing step were carried out to obtain 1000 positive pressure canned food. It has been found that out of these cans, 250 cans had local buckling deformation in there internal rising walls, being short in pressure resistance under the conditions of internal pressure. Further, the remaining canned food free from buckling also has relatively large deformation of the flat in the vicinity of the annular bead. It has been found upon conduction of tap test that there are a number of canned food which are different from frequency characteristics of cans not subjecting to the retort processing, failing to obtain the tap test aptitude.

Comparative Example 2

1000 positive pressure canned food of 190 g of milk coffee were obtained similarly to Example 1 and Comparative Example 1 except that the quantity of liquid nitrogen was reduced so that the can internal pressure is 0.1 kgf/cm^2. The obtained canned food were that in all the cans, the strength of a can was short, and handling at the time of transportation or vending machine was impossible.

Comparative Example 3

In the seamless can of Example 1, a diameter of a flat was changed to 44 mm to try to obtain seamless cans under the processing conditions similar to those of Example 1. However, a crack occurred in an annular groove, failing to process cans.

Comparative Example 4

In the seamless can of Example 1, a diameter of a flat was changed to 26 mm to obtain seamless cans under the processing conditions similar to those of Example 1, and obtain 1000 positive pressure cans for 190g of milk coffee through the same step as Example 1 using the seamless cans. The obtained canned food were low in pressure resisting performance of the can bottom at the time of retort processing, and all the canned food become deformed in their bottom portions due to the retort processing, failing to perform tap test.

Example 2

For examining the pressure resisting strength of can bottoms of the can having the can bottom shapes shown in FIGS. 1 and 2 and of the can having the can bottom shape shown in FIG. 3 (A), the following test was conducted.

Steel seamless cans were obtained by drawing and ironing steps so as to have dimensions of plate thickness = 0.185 mm, β=74°, h=3.3 mm, m=1.8 mm, and inside

diameter of can=52.5 mm in the shape of can shown in FIGS. 1 and 2. The internal pressure of the can was gradually raised till a pressure difference ousted and inside of a can at room temperature assumes from 0 kgf/cm^2 to 5 kgf/cm^2, and after this, the internal pressure was gradually lowered to the original 0 kgf/cm^2, in which case, the test for measuring a displacement amount of a center portion of a bottom wall was conducted. Note that in FIG. 1, the broken line indicates a state in which the can bottom was displaced at its maximum.

The results are shown in FIG. 4 (A). In the graph, the corner at the right and upper portion indicates the original point. The axis of ordinate represents a displacement amount (mm) of a center portion, and the axis of abscissa represents a can internal pressure (kgf/cm^2). As a result, the displacement amount from the initial shape of the central portion of the bottom wall at the time when the pressure difference between the can internal pressure and the outside assumes 5 kgf/cm^2 was about 1.5 mm. In the state in which the internal pressure is returned to the original, slight deformation remains, which is however a range posing no problem at all. It has been confirmed that the can was not seriously deformed such as a buckling during the pressure difference remains at 5 kgf/cm^2 but had the sufficient pressure resistance.

Example 3

The experiment similar to the above was also conducted with respect to the steel seamless can having the shape of a can bottom as shown in FIG. 3 (A). The dimensions of the can are as follows: Thickness of the body t = 0.185 mm, $\beta = 88^\circ$, h = 2.4 mm, m = 1.8 mm, and d= 52.5 mm. The results are shown in FIG. 4 (B). It has been confirmed that the can in this case also indicates the similar results.

Experimental Example

For the purpose of obtaining an aptitude range of can internal pressure for obtaining an internal pressure inspection aptitude, positive pressure specimen canned food with can internal pressure changed in the range of 0 to 1 kgf/cm^2 every can, tap test was carried out with respect to these specimen canned food, and tap test for the positive canned food was carried out. Negative pressure specimen canned food with can internal pressure varied in the range of 0 to -0.6 kgf/cm^2 of can internal pressure were prepared, and the negative pressure tap test was conducted at the can bottom. A can used is a steel can with a PET film laminated in the form of a 250 g 2-piece can. The results are given by a can internal pressure-frequency distribution curve of FIG. 5. In FIG. 5, △ indicates the positive pressure canned food, and X indicates the negative pressure canned food. The axis of

abscissa (can internal pressure) with respect to the negative canned food represents the absolute value omitting minus (-) symbol. The axis of ordinate represents the vibration frequency detected.

It is understood from the graph that in the case of the positive pressure canned food a rising inclination of the vibration frequency with respect to a rise of can internal pressure is large and a detection performance is high in the range of approximately 0.2 to 0.8 kgf/cm^2, preferably 0.2 to 0.6 kgf/cm^2. It is also found that this range substantially coincides with an inclination of an can internal pressure-frequency curve of the negative pressure canned food, and has an internal pressure inspection aptitude having a discrimination performance to a degree substantially similar to the case of the negative pressure canned food.

As described above, according to the present invention, since the can internal pressure is an extremely low positive pressure such as 0.2 to 0.8 kgf/cm^2, preferably 0.2 to 0.6 kgf/cm^2, a seamless thin can may obtain the pressure resisting strength of a can bottom which withstands the elevation of internal pressure at the time of retort processing, and since the dispersion of can internal pressure is small, the canned food has the internal pressure inspection aptitude such as tap test. The reliable detection of spoiled cans by the internal pressure inspection can be done.

INDUSTRIAL APPLICABILITY

In a low positive pressure canned food having an internal pressure inspection aptitude and a can thereof according to the present invention, it is possible to make thinner and reduce weight of container materials for canned food (contents) which are liable to be putrefied and spoiled such as low acid drinks or the like, to reduce the cost of cans, and to save resources. Further, since the detection performance of spoiled cans is high, they are useful as canned food and a can thereof which require the high detection performance of spoiled cans such as low acid drinks and canned food which are very liable to be spoiled and putrefied.